~~Addendum to:~~
Hacienda Azucarera La Esperanza (Sugar Plantation): Steam Engine & Mill
2.65 miles north of PR Route 2 bridge over Manati River
Manati
Municipality of Manati
Puerto Rico

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PHOTOGRAPHS

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Historic American Engineering Record
National Park Service
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HISTORIC AMERICAN ENGINEERING RECORD

Addendum to:

Hacienda Azucarera La Esperanza (Sugar Plantation and Mill):
Steam Engine and Mill

PR-1A

Location: Nearly 3 miles north of PR Route 2 bridge. In the Rio Grande de Manati valley, about 35 miles west of San Juan Baustista, in Manati, Municipality of Manati.

Date of Construction: Built by the West Point Foundry, New York in 1861, and soon thereafter shipped and assembled on present site.

Owner: Conservation Trust of Puerto Rico.

Significance: The La Esperanza's decorated steam engine is the only West Point Foundry beam engine known to survive. It is also the only known 6-column beam engine by any American manufacturer. Additionally, it is one of only eight beam engines of American manufacture known to exist anywhere. It was designated a National Historic Mechanical Engineering Landmark by the American Society of Mechanical Engineers in 1979.

Prepared by: This historical report is based on the text of the brochure prepared for the dedication ceremony of the hacienda's West Point foundry steam engine as an American Society of Mechanical Engineers National Historic Landmark. The brochure was prepared in 1979 by Ms. Luz M. Graziani, of the Conservation Trust of Puerto Rico.

The La Esperanza's decorated steam engine is the only West Point Foundry beam engine known to survive. It is also the only known 6-column beam engine by any American manufacturer. Additionally, it is one of only eight beam engines of American manufacture known to exist anywhere. It is properly classified as a 6-column, drop valve, side crank, beam engine with a 16-inch bore and a 40-inch stroke. When running on 60 psi of steam, the engine turned at about 20 rpm and developed approximately 25 horsepower. The cast-iron beam, pivoted at its center, serves as a rocking lever connecting the piston rod and crank. The piston produces reciprocating motion, while at the other end of the engine the crank converts this to the rotary motion needed to drive the machinery. Eccentrics controlled the steam engine's valves. The rod that transmitted motion from the eccentrics on the crankshaft to the valve shaft are missing from the La Esperanza engine.

To deliver maximum power, the La Esperanza engine had to run at approximately 20 rpm, but to extract cane juice efficiently, the mill would have had to turn much more slowly. Double-reduction gears accomplished this change in speed. The gear ratio between the engine's crankshaft and the intermediate gear shaft is 4.2:1. The ratio between that shaft and the bull-gear shaft of the cane mill is 2.4:1. Consequently, if the engine ran at 20 rpm, the mill rollers turned at just under 2 rpm.

A drive pulley powered a conveyor which delivered the cane to the mill. This conveyor (not extant) was needed to assure a flow of cane equal to the mill's capacity, which was twice that of a typical mill in Puerto Rico during that period.

A sugar mill worked efficiently only if the clearances between the rolls were carefully set. If the rolls were too close, they wasted power. If too far apart, they failed to extract all the cane juice. The clearances in this mill were set by bolts, the ends of which bore against the brass bearings of the feed and the discharge rolls. The feed and the top roll were separated by 1/2 to 1-1/2 inches, depending on the type of cane, and the discharge and top rolls were set even closer together. To resist the forces created when the mill was running, the shaft of the top roll was held by the master bolts, which also secured the mill to its foundations. The mill's cast-iron frame was reinforced by truss rods.

The parallel-motion mechanism is a combination of pivoted links. It transmits the power of the piston rod to the beam, correlating the different motions of the two. As the beam rocks, its end describes an arc of a circle. The piston rod, however, must move in a straight line to keep the piston in line with the cylinder. The parallel-motion linkage maintains the linearity of the piston rod through the geometry of the parallelogram. This ingenious linkage, devised by James Watt, was the invention of which he was most proud.

West Point Foundry

The West Point Foundry Association was established at Cold Spring, New York, by Gouverneur Kemble who, with others, were incorporated under that name. The first works was erected in 1817, and was designed for the casting and boring of cannon for the United States Navy and Army with the assurance of support and encouragement from the government.

Until 1851, the Association was operated as a private establishment by one of the proprietors who leased the shares of others. At that time, R. P. Parrott, who had become connected with the works in 1836, leased the shares of Kemble and the other proprietors and became the sole lessee, assisted in the management by Gouverneur Paulding. Parrott was a graduate of the U.S. Military Academy at West Point, and a captain in the Ordnance Department of the United States.

A problem arose when the cannons were not ordered in such quantities or with such regularity as to give steady employment. Other work necessarily was sought, and the West Point Foundry turned gradually to the manufacture of general castings, steam engines and boilers, and other heavy equipment, with a forging department capable of making the heaviest pieces.

Among the products of the foundry were the engines of the U.S. Naval steamers "Missouri" and "Merrimac," the Cornish pumping engine for the Jersey City Waterworks at Belleville, and the pumping engine of the drydock at the Brooklyn Navy Yard. Sugar-mill machinery, steam engines, hydraulic presses, and blowing engines, all of the largest size, were turned out in quantity. A wide range of more routine products also was produced such as cast-iron water pipe, wrought-iron shafting, and a line of general castings and forgings. Much of this machinery and other equipment was exported and was highly reputed in comparison with that of other countries. The establishment that originally was a cannon foundry of moderate size, costing about $90,000, grew to one of immense capacity, employing at times as many as 1,000 men.

The location of the West Point Foundry at Cold Spring was determined by two considerations: one, the U.S. Government's desire that a gun foundry not be too near the coast and, the other, the availability of water power from a stream entering the Hudson River at Cold Spring. The name West Point Foundry arises from the fact that Cold Spring was then only a small landing place of three houses and West Point was the only well-known place in the vicinity, although on the opposite side of the Hudson.

The West Point Foundry came to prominence in connection with the manufacture of rifled cannon. Numerous experiments with its manufacture had been made in Europe, and in 1858 and 1859 many tests were made in the United States, chiefly with guns ordered by the Ordnance Department according to plans and specifications brought forward by different inventors. The cannon were, as usual, of cast iron, bored somewhat smaller than normal, and rifled. A projectile frequently used at the time was that of Dr. J. B. Read of Alabama, in which a cup or flange of wrought iron was cast in the projectile. It was expected that the force of the explosion would cause the rim of the cup to take the grooves. Other forms of projectile were later devised, based on an improvement by Parrott of swaging out the cup partially to the form of the grooves, thus facilitating the "taking" of them at firing.

In 1860, Parrott introduced the first of the guns now known as "Parrott Guns." One peculiarity of the Parrott gun was a band or reinforcement of wrought iron at the breach end, made by coiling a bar of iron upon a mandril, and then welding this coil into a cylinder which was afterward bored, turned, and shrunk upon the gun.

The Parrott gun was refined again and again, becoming the main armament used both by the Army and the Navy during the American Civil War. It was of two types: one that was suitable for operation in mobile conflict and a heavier gun for stage purposes. They contributed largely to the victories of the Union forces at Fort Macon and Fort Pulaski. At the bombardment of Fort Sumter from Morris Island, as well as in the shelling of Charleston, Parrott Guns were used almost exclusively.

Among the many other accomplishments of the West Point Foundry Association was the manufacture of "Best Friend of Charleston", the first locomotive built in America for actual service on a railroad. The West Point Foundry was also responsible for building the second American locomotive, aptly called the "West Point," for the South Carolina Canal & Railroad Company in 1831. According to Matthews, this locomotive had the same size engine, frame, wheels, and cranks as the "Best Friend," but had a horizontal boiler with tubes two and a half-inches in diameter and about six feet long. Also in 1831, the foundry built the "DeWitt Clinton," New York's first steam locomotive. In 1832, West Point Foundry built a locomotive called "The Experiment," which set an unofficial world speed record of 80 miles per hour.

During the Panic of 1873, the West Point Foundry ran into trouble. A change in administration after Parrott's death affected the contracts. Moreover, their source of material, the iron-ore deposits near the plant, could not compete with the rich deposits found in the West. By 1886, the population of Cold Spring started declining, and in 1911 the Foundry was closed, after almost one hundred years of successful operation.

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